Reviews and Bibliographical Notes.

Die Functions-Localisation auf der Grosshirnrinde, an Thierexperimenten und klinischen Fällen nachgeinesen von Dr. Luigi Luciani und Dr. Giuseppe Seppilli. Autorisirte Deutsche und Vermehrte Ausgabe von Dr. M. O. Fraenkel. Leipsig, 1886. pp. 407.

THE LOCALIZATION OF FUNCTIONS IN THE CEREBRAL CORTEX.

To venture into the much-contested field of brain localization at the critical stage which the problem has now reached, requires no little courage; to come out of the contest victorious with some of the old problems conquered and a general clearing of the field for future contests, requires at least equal amount of scientific ability and logical acumen. To both these claims for the highest praise Dr. Luciani and Dr. Seppilli are well entitled. The authors approach the subject with a full knowledge and a worthy appreciation of the literature; they recognize that the solution of the problem not only requires difficult experiments and careful observations, but also a logical and unprejudiced interpretation of the results.

It is of course impossible and would be foolish to approach the problem as though we knew nothing of the cortex, and would consider any result as *a priori* probable as any other; but one must carefully refrain from bringing to the subject any preconceived notion of the nature or arrangement of the centres. To find an area, the removal of which will cause blindness, and call that a sight centre, is to assume that centre is a definitely limited, circumscribed collection of gray matter. If such is the case it must be established by comparison of a large number of varied experiments; not be assumed at the outset.

The problem, though apparently simple, is really very complex. To begin with, the important distinction between the phenomena due to irritation (as the effect of the lesion) and those due to the removal of a portion of the cortex (extirpation phenomena) must be made. Our authors enumerate five criteria to aid them in this problem: (1) Finding a certain disturbance as the result of a lesion, we know that the remaining functions have nothing to do with that area. This does not carry us very far. (2) By comparing the variation in the effects of the same operation in different individuals, we can arrive at the phenomena probably due to irritation, because it is not to be supposed that the irritative effect of the lesion will be the same in each case. (3) The irritation phenomena will probably affect functionally allied centres, and may thus be detected by their nature. (4) By successive operations on the same animal one not only sees the irritation phenomena change, but the compensation of function by other parts of the brain may also be detected. (5) When a small lesion produces a serious loss of function it is naturally an extirpation phenomenon.

All the effects resulting from an operation must be noticed, not only the principal one. All the senses of the animal must be carefully tested, and this is really one of the chief difficulties. A convenient set of tests applicable to the senses of a dog or ape, would be a valuable contribution to the subject. The animals must be kept alive as long as possible, and treated as one would a convalescent patient. In this way the gradual waning of the irritation phenomena comes under observation. The usual precautions during and after the operation need not be detailed here.

The arrangement of the work is admirable. The experimental and physiological portions are due to Dr. Luciani ; the clinical and pathological portions to Dr. Seppilli. The two parts are separate, and each is preceded by an historical sketch, and includes the protocol of each day's experiments and record of clinical cases.

The first chapter is devoted to the centres of the special senses, and begins with the most important and most disputed centre—the centre for vision. As the result of their experiments on dogs and apes, they conclude that if you call the sight centre all that area the destruction of any part of which will cause visual disturbance, then (in agreement with Goltz) this centre is too extended to be localized at all. But if we distinguish between transitory and permanent (though gradually decreasing) impairment of vision, we at once have the occipital lobes with a small part of the adjoining parietal marked out as the focus of the sight centre ; this centre, however, is not sharply defined, but extends to and is anatomically connected with other parts of the cortex in the direction of the frontal and temporal lobes. In this way the variations in intensity and permanence of visual disturbances following the removal of different parts of the cortex are easily explained. An injury to the "periphery" of the visual area causes less severe and less permanent loss of sight than an injury to the "focus" of the area. In apes the sight centre is more definitely localized than in dogs, and its focus is confined to the occipital lobes (in general agreement with Munk). The angular gyrus forms a part of the periphery of the centre.

The problem of the relation of each cerebral hemisphere to each half of the body is especially interesting and important in the case of the relation of each sight centre to each retina. The constant fact (first pointed out by Munk), that the extensive destruction of one occipital lobe produces *homonymous bilateral hemianopsia* (greater on the opposite eye), shows that the centre of the left side, for example, is connected with the outer (smaller) part of the left retina and the inner (larger) part of the right retina. This furnishes a simple scheme of decussation somewhat different from the current one due to Charcot. Munk's further localization of a centre for the fovea, and his view of the separate orderly projection of each point of the retina on the cortex, receive no support whatever. On the contrary, there is every proof of a thorough commingling and redistribution of the optic fibres on their way from the retina to the cortex (agrees with Goltz and Loeb). The function of the centre is not to receive the crude retinal impression, but to elaborate and associate visual images ; it is perceptive, not sensational. The general results are represented in a diagram (*v. Brain*, July, 1885) in which the crowding and size of the dots represent the "intensity" of the centre, while the shaded dots distinguish the proportionate connection of the centre with the same side of the body from its connection with the opposite side.

The centre for hearing likewise has a focus and a periphery. The focus is in the temporal lobe (the usual view) ; the periphery in the direction of the parietal and frontal, of the hippocampus, and the cornu ammonis. It is also definitely ascertained that each centre is connected with both ears, but more with the opposite, and is perceptive in its character.

As regards smell the experiments are not as conclusive. The parts adjoining the Sylvian fissure, together with the hippocampal region, are most closely related to this sense. As regards decussation the olfactory mechanism forms an exception (at least in dogs), such centre being connected to a greater extent with the nostril on the same side.

No definite results in localizing the taste centre were reached. It is evidently closely allied with smell. On the pathological side the evidence with regard to sight is in entire agreement with the experiments on animals, and thus makes these doubly valuable and doubly certain. As regards hearing, the important symptom of word-deafness (showing the perceptive character of the centre) proves to be most frequently associated with lesions of the first and second convolutions of the left temporal lobe. There is seldom a lesion on both sides and never on the right alone (in right-handed persons).

The clinical evidence regarding the olfactory and gustatory centres is as indefinite as the experimental.

The second part of the volume is devoted to the sensori-motor area. In the first place the mixed character of the area is distinctly proved. The sensory affections are mostly tactile, but also diminish sensibility to pain, to heat and cold, and to muscular inconvenience. The permanence of the effect varies as the extent of the lesion. With regard to a more definite localization of the motor centres, that is possible only when you take the degree of the effect into account. Extirpation of the fore-leg centre will affeet the hind leg as well, but less so than the fore-leg (agrees with Munk ; opposed to Hitzig and Ferrier). The sensori-motor area includes almost the whole anterior half of the brain, and is larger than the motor-excitable area. It is exclusively connected (in dogs and apes) with the opposite half of the body.

It is in this part of the subject more than in any other that pathology helps out physiology. The careful analysis of clinical cases is particularly instructive and important. It would be impossible to enter into details ; the main conclusions reached are that while the areas for the sensibility of different parts cannot be definitely mapped out, yet it is made probable that these centres have separate foci, with more or less overlapping peripheries. In this way the lower part of the motor zone is indicated as the center of facial sensibility, the upper as the centre for the sensibility of the limbs.

With regard to the separate motor centres we have another important source of evidence : in animals, electrical stimulation of the cortex ; in man, the spasms accompanying epileptic discharges. The importance of the former is well understood. The chapter treating of the latter is perhaps the best statement of the significance of cortical epilepsy to be had, and is an original contribution to the German edition. Its point of view is that of Hughlings-Jackson, and the originality and suggestiveness of that view are fully brought out. The conclusions reached agree with those of Dr. Jackson.

One general point with regard to the sense centres of the dog remains to be noticed. A small area (in the posterior part of the parietal ; Munk's zone F) is common to the centres of sight, hearing, smell, and touch. Goltz noticed the great change of character resulting from removal of this area.

The general impression of Luciani's and Seppilli's work is a decidedly hopeful one. It gives one the feeling that after all we do know something of the brain, and are on the right path to know more. When one remembers that only sixteen years ago was the electrical excitability of the cortex discovered ; and that now the combined forces of anatomy, physiology, and pathology are applied to the solution of the vexed problem, the real significance of the modern biological movement is apparent.

To those who want one single book as a compend of the best views of localization of function in the cortex, Luciani's and Seppelli's work is decidedly the one to be recommended. It represents the high-water mark of the discussion.

The important view which they hold in common with Exner, Goltz, and others, is that the brain is not composed of strictly mapped out, functionally different centres, but that it is an organ, the several parts of which are intimately and complexly interconnected in such a way that one portion is more closely related to certain functions than another. They also deserve special credit for the method of successive operations on the same animal —a method which rules out many disturbing influences and will doubtless be adopted by others.

Dr. Fraenkel has performed a valuable service in his admirable translation of this important work into a language in which it is more apt to gain due recognition. JOSEPH JASTROW.